I, the undersigned, who have prepared English translation which is attached herewith, hereby declare that the aforementioned translation is true and correct translation of officially certified copy of the Korean Patent Application No. 10-2003-0049116 filed on July 18, 2003.

Translator:
KANG, Hyun-Sun
Date: May 18, 2009

【ABSTRACT OF THE DISCLOSURE】

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The present invention is applied to a power saving operation method used in a wireless Internet system for increasing efficiency of a power saving operation method in which a sleep interval is exponentially increased when no data to be transmitted to a terminal exists. A conventional power saving operation method in which the sleep interval is exponentially increased is advantageous when no data to a specific terminal exists, but it has complexity in individual update of a sleep interval of each terminal. The present invention relates to a method for matching listening intervals of terminals that enter a sleep mode in a power saving operation system having an exponentially increasing sleep interval, and a method for utilizing the same. The present invention relates to a method for grouping terminals in a sleep mode so that terminals can be easily managed and existence of data to the corresponding terminal can be easily and promptly detected to thereby increase power saving efficiency and simplify system complexity.

【Representative Drawing】

FIG. 4

【Index】

Wireless Internet system, power consumption, power saving operation, sleep mode, listening interval

【SPECIFICATION】

【TITLE OF THE INVENTION】

METHOD AND APPARATUS FOR MOBILE TERMINAL POWER SAVING IN WIRELESS INTERNET SYSTEMS

【BRIEF DESCRIPTION OF THE DRAWINGS】

FIG. 1 shows a power saving operation mode having a periodic sleep interval.

FIG. 2 shows a power saving operation mode having an exponentially increasing sleep interval.

FIG. 3 shows a method for combing an exponentially increasing sleep interval with a periodic sleep interval.

FIG. 4 shows arrangement of a terminal having 2N sleep interval and terminals respectively having 4N, 8N, and 16N sleep intervals according to a time point of an initial entry of the sleep interval.

【DESCRIPTION OF THE INVENTION】

【[OBIECT OF THE INVENTION】

【TECHNICAL FIELD OF THE INVENTION AND THE RELATED ART】

The present invention relates to a wireless Internet system. More particularly, it relates to a method for applying a power saving mode of operation to reduce power consumption of a terminal in a wireless Internet system, and a structure of a transmitting/receiving device.

In order to provide mobility to a terminal in a wireless Internet system, power saving mode of operation (also, referred to as a sleep mode) should be

provided for reducing power consumption of the terminal. Various wireless Internet systems (IEEE 802.11a, IEEE 802.16e, and HIPERLAN/2) have been providing various methods for reducing power consumption.

Conventional power saving mode of operation methods have been proposing methods for reducing power consumption during a long-term sleep interval by setting a constant sleep interval and continuously controlling the constant sleep interval when the terminal enters a sleep mode or increasing a sleep interval set when the terminal enters a sleep mode a predetermined number of times if no data transmitted to the corresponding terminal exists during a listening interval.

Among the above methods, the former is advantageous in power saving operation mode for a regular interval or a long period of interval, but is inappropriate for, for example, Internet traffic, which has long range dependence. On the other hand, the latter method of applying the exponentially increasing sleep interval is efficient to, for example, the Internet traffic having long range dependence, but it increases system complexity for managing a sleep interval or a listening interval for each terminal. In addition, it is difficult to efficiently save power of the terminal for traffic having a fixed long period of interval.

As described, the two methods have advantages and disadvantages, and complementary to each other.

【TECHNICAL OBJECT TO BE ACCOMPLISHED OF THE INVENTION】

The present invention has been made in an effort to provide a method for efficiently terminal saving power consumption on traffic having long range dependence and traffic having periodicity.

In addition, the present invention provides a power saving operation method that can be applied not only to an exponentially increasing sleep internal but also to a sleep interval having periodicity, and an apparatus using the same.

In addition, the present invention provides a method for managing sleep intervals and listen intervals of terminals not by individually but by grouping the terminals, and an apparatus using the same.

In addition, the present invention provides a method for checking existence of traffic transmitted toward a terminal in a physical layer so as to minimize power consumption and reduce detection time during a listen interval, and an apparatus using the same.

【DETAILED DESCRIPTION OF THE INVENTION】

According to an exemplary embodiment of the present invention, when applying a power saving operation mode to minimize power consumption of a terminal in a wireless Internet system, listen intervals of terminals are arranged in the case that a sleep interval is exponentially increased.

A power saving operation method according to an exemplary embodiment of the present invention enables a terminal to promptly perceive existence of data transmitted toward the terminal during a listen interval through announcement to a group in the first half period of a downlink frame.

A power saving operating apparatus according to an exemplary embodiment of the present invention uses the power saving operation method in order to reduce power consumption of a terminal.

Hereinafter, an exemplary embodiment of the present invention will be described in further detail with reference to the drawing.

FIG. 1 shows terminals operable by a power saving operation mode having a periodic sleep interval.

As shown in FIG. 1, MT3 listens to a frame once for each N-frame, MT2 listens to a frame once for each N/2-frame, and MT1 listens to a frame once for each N/4-frame. Therefore, broadcasting information that needs to be listened by MT1, MT2, and MT3 is broadcast once for each N-frame, and information that needs to be transmitted to a specific MT1 is broadcast by a subframe with a period of an N/4 frame. Here, the broadcasting information has a broadcasting characteristic according to a characteristic of a radio channel. As described, when the power saving operation mode having periodicity, terminals can be managed by grouping them and therefore management repetition for each terminal can be avoided.

On the other hand, when traffic transmitted toward the corresponding terminal does not have periodicity, particularly, when the traffic has long range dependence, the traffic has a strong concatenation characteristic so that traffic is concentrated during a traffic existing period but no traffic exists for a long period of time during a no-traffic existing period, and therefore efficiency of the power saving operation mode is reduced with respect to such a characteristic of the traffic.

FIG. 2 shows a power saving mode operation with an exponentially increasing sleep interval.

As described, if the traffic has the long range dependence, it is more desirable to increase the sleep interval when existence of no traffic is perceived. Therefore, the power saving operation mode having the exponentially increasing

sleep interval is advantageous for, for example, Internet traffic which having the long range dependence.

On the other than, the power saving operation mode having the exponentially increasing sleep interval is inefficient to traffic having periodicity.

FIG. 3 shows a method that combines the exponentially increasing sleep interval and a sleep interval having periodicity according to the present invention.

Since the traffic having periodicity is predictable, a sleep interval of the traffic can be set according to the periodicity when the traffic enters a sleep mode, and therefore it is controlled that the maximum value of the sleep mode corresponds to the interval of the periodic traffic.

In addition, power saving efficiency can be maximized by entering the sleep mode through a method in which existence of traffic having long range dependence (unpredictable traffic) is checked at each listening period and a sleep interval is increased when the traffic does not exist.

However, application of the method of FIG. 3 may also have a drawback. If Individual terminals that enter the sleep mode have different sleep mode entry time and/or a sleep interval and/or a listening period, a base station (or, an infrastructure) that manages the terminals may have an excessive load for checking existence of data to each terminal and performing a sleep interval update process for each frame for the respective terminals in the sleep mode. In addition, it is difficult to recall a base station and the corresponding terminal if a listening period of each terminal mismatches or announcement of existence of traffic is not perceived.

Therefore, in order to overcome the above problem, a method for grouping terminals that enter the sleep mode is required. When the terminals are grouped, the base station checks terminals and updates a sleep interval in a specific group rather than checking all the terminals and updating sleep intervals so that a control load of the base station can be reduced. In addition, the base station reports existence of traffic to a terminal for each basic unit frame (N-frames in FIG. 2) rather than reporting it for each frame, and accordingly a load related thereto can be reduced.

From the viewpoint of the terminal, when terminals are not grouped, each terminal should check existence of traffic for the corresponding terminal through a traffic announcement message including an identification (ID) of the terminal. Here, the traffic announcement message implies a message including an ID of a terminal as a parameter for indicating existence of traffic for a specific terminal, and no specific realization is prerequisite. On the other hand, when terminals are grouped, existence of a traffic announcement message for a specific group can be announced in a flag format such as system information that can be temporally advanced and checked in a lower layer (e.g., physical layer). When perceiving a flag indicating that no traffic announcement message for the group where the terminal is included exists, the terminal can stop an unnecessary process for checking the message and enter the sleep mode, thereby further saving power.

The present invention proposes a method for grouping terminals that enter a sleep mode in a predetermined group. In FIG. 4, when a terminal having sleep interval 2 enters a sleep mode, a sleep interval of the terminal is

continuously increased to 4N, 8N, 16N, 32N, ... if no traffic toward the terminal exists at initial entry location of 2, and terminals having such a period are grouped and arranged. When the maximum window size is Wmax, a listen interval of a terminal having initial sleep interval of 2m with a listen interval of terminals each having a sleep interval that is longer than 2m can be arranged by controlling the entry time period for the remainder of dividing a frame number by Wmax to be 2m.

In addition, according to existence of traffic, a group in which a specific terminal is included is updated en bloc when no traffic transmitted toward the specific terminal exists so that a management load of a base station can be significantly reduced.. In addition, existence of traffic for a terminal in a specific group can be announced before traffic announcement for each terminal, and therefore the terminal can be returned to a sleep mode if no traffic exists.

【Advantageous Effects】

According to the present invention, complexity in individual management of sleep and listen intervals of each of the terminals according to the conventional methods can be reduced by grouping sleep intervals and listen intervals of all the terminals, and additional power saving can be achieved by controlling the respective terminals to promptly perceive data transmitted toward the corresponding terminal.

【CLAIMS】

【Claim 1】

A method for applying a power saving operation mode for minimizing power consumption of a terminal in a wireless Internet system, the method comprising arranging listen intervals of terminals having exponentially increasing sleep interval.

【Claim 2】

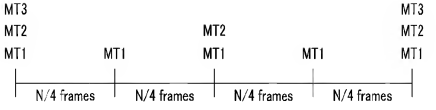
The method of claim 1, wherein the terminal promptly perceives existence of data transmitted toward the terminal during a listen interval by a reporting for a group during the first half period of a downlink frame.

【Claim 3】

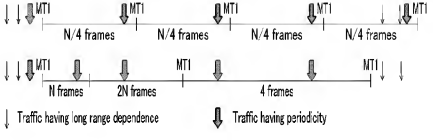
An apparatus for reducing power consumption of a terminal by using the method of claim 1 or claim 2.

【Drawings】

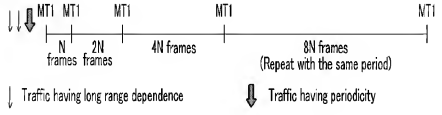
【Fig. 1】



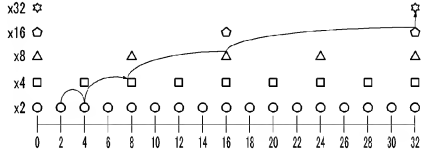
【Fig. 2】



【Fig. 3】


MT1
MT1
MT1
MT1
MT1
N frames
2N frames
4N frames
8N frames
(Repeat with the same period)
Traffic having long range dependence
Traffic having periodicity

【Fig. 4】


x32
x16
x8
x4
x2
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32